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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/734,110	12/15/2003	Russell Childs	Q78999	4858

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EXAMINER	
KIM, JOANNE H	
ART UNIT	**PAPER NUMBER**
2883	

DATE MAILED: 06/15/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/734,110	CHILDS ET AL.	
	Examiner	Art Unit	
	Joanne H. Kim	2883	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 21 March 2005.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-20 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) 19 and 20 is/are allowed.

6)☒ Claim(s) 1,2,5-8,10,11 and 13-18 is/are rejected.

7)☒ Claim(s) 3,4,9 and 12 is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 15 December 2003 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1, 2, 5-7, and 15-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Soref (U.S. Patent No. 5,838,870).

Soref discloses an optical device and a method of fabricating the optical device comprising: forming a first cladding layer on a silicon substrate; forming a core material layer on the first cladding layer; etching to form a waveguide core, the etching step removing material from the core material layer and material from the first cladding layer so that the first cladding layer forms a mesa formation covered by the waveguide core; and forming a second cladding layer over the first cladding layer and the waveguide core, wherein the first cladding layer is predominantly silicon dioxide, the cross section of the waveguide core has a square shape, and the width of the mesa formation is equal to the width of the core (Figs. 2A and 2B; and column 3, lines 22-34 and 40-41). Soref also discloses that the first cladding layer structure, which includes the mesa

formation, makes possible high Q optical resonators in the waveguide (column 5, lines 29-31).

Soref does not specifically disclose that the height of the mesa formation is selected so as to give a substantially zero birefringence (or a desired reduced level of birefringence) in the waveguide core.

It is well known that Q-value is inversely proportional to birefringence (for example, see column 8 of Tarazona (U.S. Patent No. 6,453, 086). Since Soref discloses that the optical isolation provided by the mesa formation makes possible high-Q optical resonators, Soref implicitly discloses (in addition to being obvious) that the mesa formation of the first cladding layer makes possible to provide low birefringence, such as zero birefringence, or reduced birefringence. Further, it is obvious that since the height of the mesa formation determines the degree of optical isolation, which in turn determines Q-value, the height of the mesa formation causes variation of birefringence level.

Accordingly, it would have been obvious to select the height of the mesa formation to reduce birefringence to substantially zero or a desired reduced level.

The motivation would have been to provide an optical device having high Q-value and enhanced performance.

4. Claims 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Soref in view of Bosso et al. (U.S. Patent No. 6,282,332, hereinafter "Bosso"), and further in view of Kawachi et al. (U.S. Patent No. 4,781,424, hereinafter "Kawachi").

Soref discloses that the height of the mesa formation is selected to provide a substantially zero birefringence in the waveguide, as discussed above.

Soref does not disclose that the stress in the second cladding layer, the stress in the core, and the width of the waveguide core are selected to provide substantially zero birefringence in the waveguide.

Bosso discloses that a width of a waveguide core causes variation of birefringence (column 4, lines 29-36). Kawachi discloses that stress in a second cladding layer and stress in a core of a waveguide induce birefringence (column 1, lines 46-50; column 2, liens 57-63l; and column 3, lines 37-39).

It would have been obvious to select all of the height of the mesa formation, the stress in the second cladding layer, the stress in the core, and the width of the waveguide core to provide substantially zero birefringence in the waveguide.

The motivation would have been to provide high performance waveguide since all of the listed parameters cause variation of birefringence.

5. Claims 8, 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Soref in view of "Birefringence Free Planar Optical Waveguide Made by Flame Hydrolysis Deposition (FHD) Through Tailoring of the Overcladding" by Kilian et al. (hereinafter "Kilian").

<u>Regarding claim 8</u>, Soref discloses the method of fabricating an optical device as discussed above.

Soref does not disclose that coefficient of expansion of the material of the second cladding layer is greater than that of the material of the core.

Kilian discloses birefringence free planar optical waveguide. Kilian discloses that birefringence is reduced in a waveguide including a second cladding layer made of material that has coefficient of thermal expansion greater than that of material of a core (pages 196-197, second column, lines 6-14, and Table II).

It would have been obvious to modify Soref so that coefficient of expansion of the material of the second cladding layer is greater than that of the material of the core.

The motivation would have been to improve performance of the waveguide by reducing birefringence.

Regarding claims 13 and 14, Soref discloses the method of fabricating the optical device as discussed above.

Soref does not specifically disclose that the width of the waveguide core is selected to be 6 μm.

Kilian discloses that a width of the waveguide core is selected to be 6 μm (page 196, the first column, lines 18-19).

It would have been obvious to select the width of the waveguide core to be 6 μm since a width of a single-mode waveguide core is 6 μm in general.

Allowable Subject Matter

6. Claims 3, 4, 9, and 12 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 3, 4 and 9 are allowable over the prior arts of record because the prior arts of record do not disclose nor render obvious a method for fabricating an optical device comprising a first cladding layer forming a mesa formation having a height of at least 1 μm or between about 2 μm and about 4 μm.

Claim 12 is allowable over the prior arts of record because the prior arts of record do not disclose nor render obvious a method for fabricating an optical device comprising: selecting the stress in a second cladding layer to be in the range of –20 to +10 MPascals.

7. Claims 19 and 20 are allowed.

The prior arts of record do not disclose nor render obvious an arrayed waveguide comprising: a first cladding layer including a mesa formation; a plurality of array waveguides, each of which having a waveguide core formed on the first cladding layer so that the waveguide core substantially covers the mesa formation; and a second cladding layer formed over the waveguide cores and the first cladding layer, wherein the height of the mesa formation is in the range of about 2 to 4 μm, the stress in the second cladding layer is in the range of –20 to +10 MPascals, and the width of the waveguide cores is in the range of 5.80 and 6.20 μm.

Response to Arguments

8. Applicant's arguments filed March 21, 2005, have been fully considered but they are not persuasive.

Regarding claims 1 and 16, Applicant argues that

> "First, the Examiner says that Soref's disclosure teaches that his 'first cladding layer structure, which includes the mesa formation, makes possible high Q optical resonators in the waveguide.'
>
> The Examiner may be correct that Soref's first cladding layer structure helps to make high Q optical resonators possible, but the cited language of Soref does not say that his mesa formation is the reason.
>
> Soref's actual language is: 'a key aspect of the insulating lower cladding layer is that it makes possible high-Q optical resonators in the strip guide as shown in Fig. 4, because of the large index step and the consequent optical isolation.'
>
> In other words, Soref is saying that high-Q optical resonators are made possible because the refractive index of the lower cladding layer is much less than the refractive index of the core layer... It is this large step in index of refraction (not the physical step of the mesa structure) which the cited language of Soref teaches as making the high-Q optical resonators possible.
>
> Therefore the Examiner is incorrect in implying a teaching in the cited language of Soref that it is his mesa formation which "makes possible high Q optical resonators in the waveguide."

In contrast to Applicant's assertion that the cited language of Soref teaches that it is the large step in index of refraction (not the mesa structure) that makes high-Q optical resonators possible, Soref's actual language (as Applicant stated above) clearly states that high-Q optical resonator is made possible because of the <u>large index step **and** the consequent optical isolation</u> (not only because of "the large step in index of refraction" as Applicant asserts). Soref discloses that the first cladding layer structure, which includes the mesa formation, makes possible high Q optical resonators in the waveguide because of the optical isolation provided by the mesa formation and an oxide layer formed above the core (column 5, lines 22-31). Clearly, the first cladding

layer structure makes possible high-Q optical resonators by providing optical isolation (by using mesa formation). Therefore, Soref does implicitly disclose that the mesa formation of the first cladding layer makes possible high Q optical resonators.

Furthermore, Applicant argues that

> "the Examiner's position that "it is well known that Q-value is inversely proportional to birefringence," is completely unsupported. Birefringence may be one of many factors that can reduce the Q value of a structure, but there is no such "well Known" principle "that Q value is inversely proportional to birefringence... Applicants respectfully request that the Examiner cite a reference in support of her position...."

Tarazona (U.S. Patent No. 6,453,086) discloses that the elimination or reduction of birefringence is greatly desired because birefringence degrades the extinction ratio at the output of an optical device, which causes low Q-value. Tarazona discloses that one measure of birefringence is the Q-value and the Q-value is inversely proportional to birefringence (column 4, lines 44-47; column 7, lines 47-51; and column 8, lines 13-14). Further, Gordon et al. (U.S. Patent No. 6,519,027) discloses that birefringence causes polarization mode dispersion, which causes random signal fading, increased composite second order distortion and increased error rates, which in turn causes low Q-value. Also, for example, see Kawachi et al. (U.S. Patent No. 4,781,424) and Bosso et al. (U.S. Patent No. 6,282,332).

Moreover, Applicant argues that

> "Applicants claim 1 calls for the height of the mesa formation to be 'selected so as to give a substantially zero birefringence in the waveguide core.' ... The Examiner has not cited anything in Soref that teaches or suggests that the mesa height be selected to give substantially zero birefringence."

In paragraph 3 above, Examiner acknowledged that Soref does not disclose that the height of the mesa formation is selected so as to give a substantially zero birefringence in the waveguide core. Then, Examiner stated that since it is well known that Q-value is inversely proportional to birefringence and Soref discloses that the optical isolation provided by the mesa formation makes possible high-Q optical resonators, Soref implicitly discloses that the mesa formation of the first cladding layer makes possible to provide low birefringence, such as zero birefringence, or reduced birefringence. Further, Examiner stated that it is obvious that since the height of the mesa formation determines the degree of optical isolation, which in turn determines Q-value, the height of the mesa formation causes variation of birefringence level. Therefore, it would have been obvious to select the height of the mesa formation to reduce birefringence to substantially zero to make possible high Q optical resonators (see paragraph 3 above).

Regarding claim 2, Applicant repeats the same arguments stated above. See above for the response to the same arguments.

Additionally, Applicant argues that

> "the Examiner has also failed to show any teaching in Soref that the height of the mesa formation is selected to give "a desired reduced level of birefringence" in the waveguide core, as called for in Applicant's claim."

As stated in paragraph 3 and the response to the arguments regarding claims 1 and 16 above, Examiner acknowledged that Soref does not disclose that the height of the mesa formation is selected to give a desired reduced level of birefringence in the

waveguide core. However, as stated above, it is obvious that since the height of the mesa formation determines the degree of optical isolation, which determines Q-value, the height of the mesa formation causes variation of birefringence level. Therefore, it would have been obvious to select the height of the mesa formation to give a desired reduced level of birefringence (see paragraph 3 above).

Conclusion

9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Joanne H. Kim whose telephone number is (571) 272-2139. The examiner can normally be reached on 8:30 a.m. to 5:00 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Frank G. Font can be reached on (571) 272-2415. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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